Manual
FOR
Physical Measurements.

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UNITED STATES OF AMERICA.

Manual

for

Physical Measurements

in connection with the

Association Gymnasium Records.

LUTHER GULICK, M. D.

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THE INTERNATIONAL COMMITTEE
OF YOUNG MEN'S CHRISTIAN ASSOCIATIONS,
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Manual for Physical Measurements.

In order that the anthropometric statistics taken by the Young Men's Christian Associations might be of greater value than formerly, it was thought wise that some definite and uniform system be prepared.

Accordingly, during the winter of 1887-'88, an outline was prepared and presented for criticism to Prof. Edward Hitchcock, M. D., of Amherst College ; Prof. J. W. Seaver, M. D., of Yale ; Wm. Blaikie ; Prof. D. A. Sargent, M. D., of Harvard ; Prof. W. W. Ranney, of Williams College ; J. Gardner Smith, M. D., of the Young Men's Institute, New York City ; W. S. Sheldon, of the Cleveland Y. M. C. A., and others.

These gentlemen discussed every item in detail, suggesting alterations and additions that would render the form more valuable. After this preparatory criticism, a meeting was held in May, 1888, for a final revision. There were present Prof. Edward Hitchcock, M. D.; Wm. Blaikie ; Prof. J. W. Seaver, M. D.; Prof. W. W. Ranney ; J. Gardner Smith, M. D.; T. M. Bull, M. D., of New York City; R. R. McBurney, General Secretary of the New York City Association ; R. C. Morse, General Secretary of the International Committee ; Rev. D. A. Reed, O. C. Morse, J. T. Bowne, R. J. Roberts, and Luther Gulick, of the Association Training School at Springfield, Mass.

At this meeting the blank was further revised and recommended for adoption by the Associations.

The blank, as finally prepared, was presented to the International Conference of General Secretaries at its meeting in Grand Rapids, Mich., in June of the same year. After an animated discussion, it was unanimously recommended for adoption.

In the winter of 1890-'91, after two years use, a new edition was needed. Some that had used the blanks desired more details, while others felt that a simpler examination would be advantageous Accordingly two blanks have been prepared, one decidedly shorter and the other much more full than the former one. The large form has in it all that was in the former blank, and considerable more. The small form, which is given on page 8 of this book, contains no new measurements, and some of minor importance have been omitted.

The large blank was not prepared with the idea that it should be used in all its details for all individuals, but rather that, when special care had to be taken in any case, there would be opportunity for such measurements as were desired. There is a growing feeling on the part of many, which is apparently warranted by the facts, that there has been, in some cases, too much time spent upon mechanical details.

It is the judgment of the Committee that the small blank is better adapted for general use, and the large one for unusual cases that need a more detailed record. It is not intended that a thorough examination should be dispensed with, but that the mechanical part of it should consume less time, and that the more vital part of the personal examination should be more thorough than ever. The movement which emphasizes the necessity of testing what a man can do, appears to be in the right direction. The capacity of a muscle for work is more fundamental than its size or shape, and determines its form more than

its form determines its capacity. The means for testing in these directions are, however, still limited. It is believed that there will be growth in this direction, and that the present form of anthropometric blanks is not the final one.

It will be noticed that some paragraphs throughout the book are in small and some in large type. Those in large type apply to both systems, while those in small type apply only to the full system.

It is the conviction of those that have given the closest study to anthropometry, that uniformity is fundamental to good work, or, in other words, that it is essential that men be measured alike. To illustrate, let us suppose three physical directors measuring a man's chest. One gets a measurement of 40 inches, another of 38, and a third of 36 inches. It would be easy to account for these differences. Perhaps one man took the measurement with the tape passing around the upper part of the axilla, after a vigorous inhalation ; another took the measurement just below the scapulæ and over the pectoral muscle, after an inhalation; while a third took it below the pectoral muscle, with the chest as nearly as possible at the normal. It is important not merely that the measurements be taken in the same places, but that they be taken according to directions. One director, for instance, has taken the depth of the chest with calipers having straight arms. This gives on the average a depth greater than if the measurement had been taken with the ordinary bent arm calipers, according to directions, and would show that these men had deeper chests than those of other gymnasiums, which would be incorrect, as the apparent increase was made simply by faulty measurements. It is evident that statistics taken in this way will be worthless, as far as comparison is concerned.

It will be noticed that the tape recommended has on it

a spring that will give a uniform tension. This is important, in order that the tape may always be pulled with approximately the same force ; for, in the larger measurements, as of the waist, a difference of one or two inches is readily made by a difference in the tension. It would be out of place here to go into a discussion as to the value of accurate measurements. It is hoped that this may be treated somewhat at length in a later volume, also the subject of charting, and the application to physical education of the knowledge given by anthropometry.

The page of records is divided into two parts : one entitled *History* and the other *Examination*. The history is to be filled out first, and refers entirely to the past. In the first part will be noticed four columns for four examinations. The first column will be filled up at the first examination. The examinations should follow one another about six months apart, or, when feasible, every three months.

In deciding the selection of measurements and history certain principles have been borne in mind. *First*, those that *show what the man is ;* that give a knowledge of his present physique, so that on consulting the records later it will be possible to mark out with a fair degree of accuracy the conformation of his body. *Second*, those that show *what he can do*, which assist us in judging of the individual's qualifications for any special line of work or exercise. Thus adaptation for any given sport, such as rowing or jumping, might be indicated to a man when he is not at all acquainted with that fact. *Third*, those that show *what he may become*, which are of the greatest value in determining his latent possibilities.

The statement of these principles is necessary to those that believe that the only object of measurement is to give us a knowledge of the parts that can be affected by exercise. A common supposition is that the muscles

chiefly are affected by exercise, and consequently that the measurements known as muscular are the only ones that are of any great value. This belief, however, is based upon a misconception, for the bones are sometimes more readily affected by exercise than are the muscles. Bone girths and lengths can often be materially increased, particularly during the growing period of life, by judicious exercise and other auxiliary means. The nervous system is often affected more vitally by physical exercise than the muscular.

Opportunity is afforded for recording some measurements that will not ordinarily be needed. Thus the measurement of the length of the right shoulder to elbow and of the right elbow to knuckle will often give a sufficient knowledge regarding the arms without measuring the left, and it will also usually be unnecessary to take the measurement of more than one leg. In the case, however, of a suspected difference in the length of the legs, careful comparative measurements should be taken.

[*Small Form.*]

ASSOCIATION GYMNASIUM RECORDS. NO. —.

EXAMINATION													HISTORY.
Date.	189 .			189 .			189 .			189 .			Name.
	MO	DA	HR	MO	DA	HR.	MO	DA.	HR	MO.	DA.	HR	
TICKET:													Date of Birth:
Weight													
Height													Married:
GIRTHS:													
Neck													
Chest contracted													Exercise:
Chest expanded													
Waist													
R. Forearm													Special History, Accidents, etc.:
R. Up-arm down													
R. Up-arm up													
L. Forearm													
L. Up-arm down													
L. Up-arm up													Occupation:
R. Thigh													
R. Calf													Health: (Past)
L. Thigh													
L. Calf													
MUSCLES:													
Consistency, Arm	H	M	S	H	M	S	H	M	S	H	M	S	
Consistency, Leg	H	M	S	H	M	S	H	M	S	H	M	S	
Development, Arm	G	M	P	G	M	P	G	M	P	G	M	P	Health:
Development, Leg	G	M	P	G	M	P	G	M	P	G	M	P	(Present).
Size, Arm	L	M	S	L	M	S	L	M	S	L	M	S	
Size, Leg	L	M	S	L	M	S	L	M	S	L	M	S	
Dip													
Pull-up													

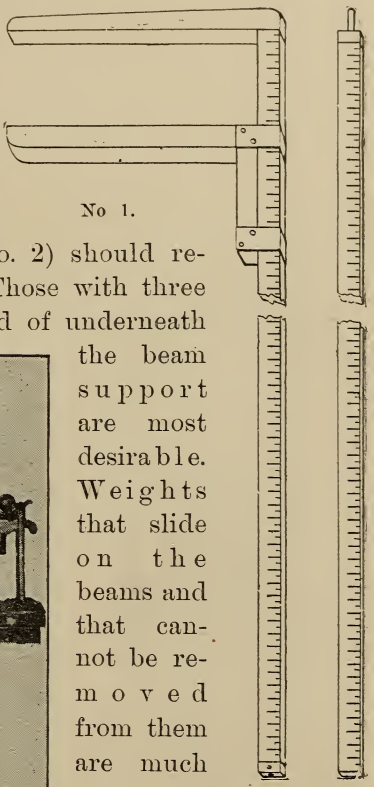
Remarks:

Prescription:

(The above is published by the International Committee, and is sold as No. 24. It is reduced in size, and spaced differently from the original, that it may occupy this page. The other form is too large to be conveniently inserted in this book.)

Anthropometric Apparatus.

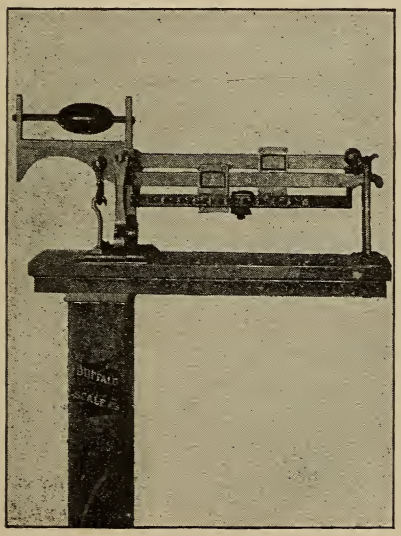
In order to make the statistics more interesting to members of the gymnasium, it has been thought best that they be taken on the English rather than the French system.



No 1.

The Height Measure (see cut No. 1) should be a stick six and one-half feet long, independent of other apparatus and divided into inches and tenths, not feet and inches.

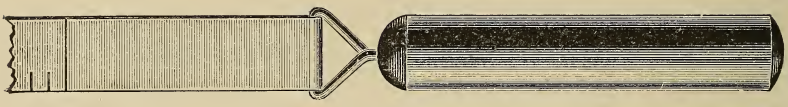
The Scales (see cut No. 2) should record pounds and tenths. Those with three beams placed above instead of underneath the beam support are most desirable. Weights that slide on the beams and that cannot be removed from them are much more convenient than loose weights.



No. 2

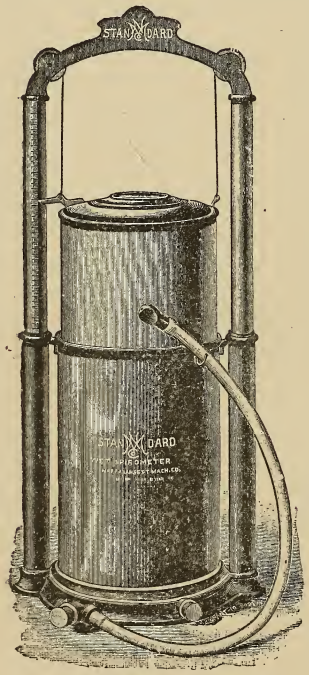
The Measurement Tape (see cut No. 3) is graduated to inches and tenths, *with a spring at the zero*

end having a mark on it that will indicate a tension of six ounces.



No. 3.

This is an important matter, as without uniform tension it is impossible to tell whether the measurements taken by different individuals correspond to each other. Thus, if I pull on the tape with a pressure of 10 ounces and some one else with 5 ounces, the measurements do not correspond. Some consider this a useless precaution, as a person after a few week's practice gets to drawing the tape uniformly. But this may be doubted, and even if true it does not at all affect the question whether two persons in different parts of the country, who have never seen each other, draw the tape with uniform tension.



No. 4.

Steel tapes are, of course, the most accurate, but they are hard to read and uncomfortable to the skin. The waterproof tapes that are generally used answer the purpose very well.

A Flat Box 13 inches in height is required in taking the height sitting, length of trunk, etc. It is important that the box be neither more or less than this height, for a variation will give considerable difference in both length of trunk and sitting height. This is owing to the altered angle of the femur with the surface of the box.

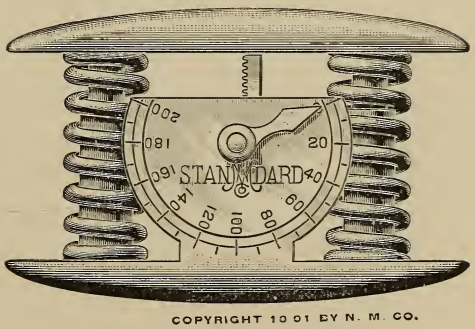
Two Pairs of Calipers are desirable, one of steel, with bent arms, and the other of wood with straight arms. It is well to have a knob or flat surface on each point of the bent arm calipers so that they shall not so readily press into the skin.

A Wet Spirometer (see cut No. 4) should be used, having large apertures both through the tube and the mouth piece, so that it will be impossible for the individual to bring any considerable pressure to bear in the lungs.

Dry spirometers are decidedly unsatisfactory unless tested every few days, as they vary in their recording.

A Back and Leg Dynamometer. (See cuts Nos. 43 and 44.) It is important that all this apparatus, particularly the dynamometer, be used only under the direction of the physical director, as serious inconvenience and even injury have resulted from misuse.

The Grip Dynamometer (see cut No. 5) should be graduated in pounds. The oval dynamometer is unsatisfactory, as pressure at the centre counts for more than pressure anywhere else. The two sides should approximate uniformly.



No. 5.

A Pair of Stationary Wall Parallels (see cuts Nos. 45–48), adjustable in height to allow of both dipping and pulling up, will be needed. A pair of rings suspended from the ceiling and a horizontal bar may be used instead of wall parallels. The adjustable parallels are, however, the more desirable, for they allow and demand that the fore-arm be held uniformly in a position of semi-supination, which seems to be the most desirable position.

Neither in the records nor in this description of instruments are stethoscope, sphygmograph or percussion hammer included. These do not come under this head, but belong to physical diagnosis.

It is to be distinctly understood that the taking of these measurements does not do away to any extent with the necessity of a careful examination of the vital organs.

It is desirable to keep photographic records of any unusual case. In this way only is it possible to illustrate graphically the work that is done in this department. Thus, a case of lateral curvature of the spine, a very marked emaciation or marked obesity, could be photographed before and after taking gymnastic treatment, much to the edification of the individual and the satisfaction of the physical director. Lantern slides will enable him to show to an audience exactly what is being done in some of these lines. Of course the identity of the individual photographed must be obscured in the slides.

History, Personal and Family.

It is quite essential that the whole matter of history be taken before the measurements, as it will guide the examiner in his later work, leading him to allow for manifestations of certain powers or weaknesses, special debility, and so on. The sum total of these little things constitutes the value of a physical examination.

Birthplace. This refers to the country or state in which the individual was born. At first sight this question does not seem important with reference to physical education. There are, however, several problems on which it may throw valuable light; for instance, knowing the state in which one's family has been living for three generations, the effects of the climate may be evident and interesting. These data give the real, not the nominal nationality of the individual. Different nationalities vary markedly in their physical characteristics, and react somewhat differently to different kinds of exercise. One would not expect a certain exercise to produce the same result upon a man of French parentage as upon a German.

The Occupation of the Father before the Son's Birth is the only indication that we have of the hereditary influence of different trades and professions. We are aware that it takes several generations to produce the best results in certain lines; glass-blowers cannot be produced in one generation, it is said So any physical power will be much more readily acquired by those whose parents were engaged in work that demanded similar abilities.

Health of Father and Mother before the son's birth. This gives opportunity to ascertain the influence of the immediate physical condition of the parents on the physical condition of the child.

Father Died at —— years, of ——. If the parents are neither of them living, both having died of consumption, one at twenty-four and the other at twenty-seven, this must be considered in the treatment of the individual. Many illustrations of

the value of a knowledge of these facts will occur to every one who has had experience. The age of the parents at death may give us an indication of family tendencies towards some special disease at a certain age.

Number of Brothers and Sisters Living—Number Dead—Cause of Death. This may seem entirely foreign to the individual, and one might naturally argue that what his brother is doing now did not affect him at all. This would be true, but it is not to the point. For the causes that affect his brother at the present time, *if they are due to hereditary influences*, may affect him in the same way. The following illustration from actual life shows the importance of this: A young man, the only survivor of six children—the other five, together with the mother, having died of consumption—has been able, by careful and systematic physical training, to gain a fine physique with a good amount of vitality. If this young man had gone into the gymnasium and been put through the exercises ordinarily given, he would no doubt have found himself following the rest of the family; but, by means of the knowledge gained by his physical trainer of the hereditary tendencies of the family, the above results were accomplished.

Diseases in Family. This refers to hereditary diseases. A single instance of any given disease would not indicate that the disease was hereditary. But several instances among one's relatives would render it probable that the disease was hereditary, and, if possible, exercises should be given designed to combat it.

Early Life, City or Country. In the previous questions nothing is said of the town in which the individual was born. This question endeavors primarily to secure record of his conditions and surroundings in early life. Many of the most difficult problems in connection with physical education to-day are those growing out of the altered conditions of life, depending upon the removal of such a large portion of the population from the country to the city.

Exercise (past) Work. This refers, under the two headings, Physical and Mental, to the kind and quantity of work upon which the individual in question has depended for his livelihood during and since boyhood, and should answer the question: "What various kinds of mental and bodily occupation have you been engaged in during and since boyhood?"

The kind and quantity of work to which the individual has

been accustomed will account to a very large extent for his present physical condition. In general, the boy that has been doing work that involved considerable muscular expenditure will be found to have a markedly different physique from the boy that has done little but go to school.

Exercise (past) Recreation. This should answer the questions: "In what form have you been accustomed to take your recreation?" "Have you ever engaged in athletic or acrobatic work?" If the individual has indulged to any considerable extent in any of the forms of recreation mentioned in the blank, a check mark should be made under the proper subhead.

Mental Recreation. If he has done a large amount of chess playing, checker playing, music, and the reading of light literature, this might be indicated.

Surgical Operations, Strains, Accidents, Injury. Often examination is made of men that have suffered a severe sprain or accident or have been injured in a way that might disqualify them for some kinds of exercise, but that they would fail to speak of unless questioned. Especial note should be made of any such cases under the heads of Special History, Accidents, Surgical Operations, etc.

Health and Disease (past). Inquiry should be made of the member whether he was vigorous and robust as a boy. If he had any of the diseases mentioned in the blank, indicate the same by check across the name of the disease. Ascertain whether the recovery was complete or not, and anything else bearing upon the subject, and if anything especial is discovered enter it under the head of Remarks. Often the key to what would otherwise be unsolved can be discovered here.

This is the best opportunity to find out about the vigor of the individual. For no matter what the apparent present physical condition is, the man that has been vigorous all through his boyhood will be able to take up

exercise that would be out of the question for one that was delicate as a boy. The consequences of any of these diseases that the individual may have had must needs be borne in mind in the prescription of exercise. For instance, rheumatism in a child often leaves a certain heart disease.

Color of Eyes. Light, dark, or mixed. This gives indications as to temperament.

Color of Hair. Record whether it is light, dark, or red.

Temperament. Here should be recorded the judgment of the examiner in regard to the temperament of the individual. This is an indefinite or intangible thing, and the definitions ordinarily given seem unsatisfactory. It will, however, be perfectly simple to mark those that are of a distinctively nervous temperament and those that are phlegmatic. This distinction will be valuable.

Vision and Hearing. Every one needs to know that his eyes are in good condition. Many are obliged to do work that involves good eyesight, and many suffer without knowing that the cause of their suffering is some trouble with the eyes. It is possible in a few moments to form a judgment in regard to the condition of the eyes, whether it is normal or not, and to record it. If they are not normal, the subject should be sent to the oculist.

Business Hours Daily. This refers to the number of hours that the individual spends at his work. Often this will determine the amount that he will be able to do in the gymnasium.

Hours in the Open Air. Record the total number of hours, whether in work, play, or travel.

Hours of Sleep. This refers to the time spent in sleep and not simply resting in bed. For instance, 10 P. M. to 6 A. M.

Tobacco. If the subject uses tobacco at all, record it, with the quantity used. Let capital S stand for cigar, small c for cigarette, and W for chew, so that an individual record reading 7S would mean that he smoked on the average 7 cigars a day. This is an important question with reference to physical training, as no man who is using tobacco can expect to do the best work physically. Careful comparison of the present records would probably enable us to answer questions along this line much more definitely than can now be done.

STIMULANTS. The kind and quantity of stimulants used by the subject, and also whether they are taken solely in connection with meals or not. If the latter draw a small circle in the left hand corner of the space. Tea and coffee come under the general head of stimulants. The men that have the best control over themselves seem to be those that take no stimulants whatever.

MARRIED. It will sometimes be noted that married men do not respond to exercise as they should. It may be that the physical director can give them needed information.

OCCUPATION. This refers to what the individual is doing for a living. Important knowledge may thus be gained, affecting his work in the gymnasium; for if his business demands any physical work of excellence, care must be taken that the gymnasium exercise prescribed for him does not draw too heavily on the faculties that are taxed by his daily occupation.

EXERCISE, WORK. This refers particularly to the physical work demanded by his occupation, and is necessary for the same reason.

EXERCISE, RECREATION. Here record any exercise the individual is taking as recreative. Note what it is and the daily amount, for it is perfectly evident that a man who is doing vigorous physical work all the time outside the gymnasium will not need the same kind nor the same amount that he would if this were not the case.

HEALTH. This refers to the examiner's opinion of the man, and not to the man's opinion of himself. Of course, the examiner must take into consideration, and must be governed largely by what is said. In general, it will not be difficult to find out whether the subject has been suffering from any constitutional disease and whether he is constitutionally robust or delicate.

Remarks. Under this head may be placed any points about the subject that are not already fully covered.

Prescription. After the examination, the examiner makes up his mind as to the kind and quantity of exercise that should be prescribed, and records it here, using, however, such abbreviations as he may find advantageous.

Physical Measurements.

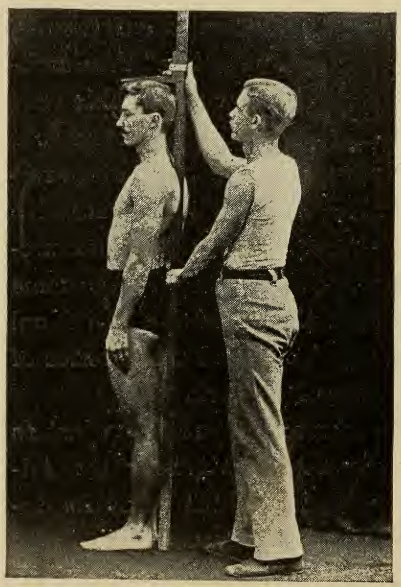
The Year, Month, Day, and Hour on which the examination is made should be noted, for the condition of the individual with reference to strength, weight, and height vary markedly in different parts of the day. For example, an examination taken at 11 A. M. would show a taller, stronger, and lighter man than the same individual measured at 7 P. M., particularly if he took a late dinner. Examinations should not be made within an hour after vigorous exercise. One of the reasons for this is that the size of the muscles is affected by exercise, which may be shown by the following experiment: Let the upper arm up be measured in any given position after a considerable rest or before it has been used vigorously. Then let the man take a dumb-bell, weighing from five to ten pounds, and exercise vigorously and rapidly, "curling" the dumb-bell and "putting it up," and using as far as possible only the muscles of the upper arm. It would be better that he remain sitting during the experiment. Let him exercise thus for ten or fifteen minutes and then measure his arm again, taking pains, of course, to have the measurement taken at the same place, with the tape at the same degree of tension as at the first time. In this individual measurement there can easily be traced a difference of from one-half to three quarters of an inch.

Many of the following measurements are taken just as recommended by the American Association for the Advancement of Physical Education, in which cases its descriptions are copied. A number of statements as to why these measurements are to be taken are also copied. These will always be found in quotation marks.

NUMBER. This refers to the total number of examinations that have been made in the gymnasium since this system was adopted. In the first book, if books are used, this number will correspond to the page number, but when the first book has been filled the numbering will keep right on in the second book, while the paging will commence over again. Thus, the last man in the first book will be on page 250 and he will be number 250, but the first man in the second book will be numbered 251, while he will be on page 1.

TICKET. Record here whether the one examined is an active or associate member.

MEASUREMENT COLUMN. WEIGHT should be taken without clothes, in pounds and tenths of pounds.



No. 6 .

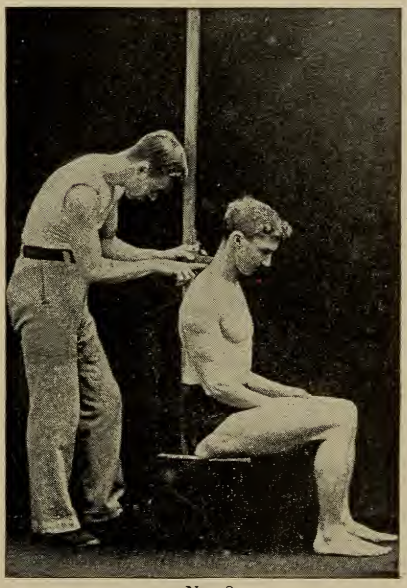
"HEIGHT (see cut No. 6) should be taken without shoes and with the head uncovered. The head and figure should be held easily erect and heels together. This position is best secured by having the heels, buttocks, and spine between the shoulders and back of the head in contact with the measuring rod."

Height Sitting. (See cut No. 7.) Have the one to be measured sit as erect as possible upon a flat box thirteen inches high. To insure erectness have him imagine that he has a weight on his head which he must raise as high as possible. Measure from the surface on which he sits to the highest point of the skull, as in the height standing. The height sitting gives the relative length of legs as compared to the sum of the body, neck, and depth of head.

No. 7.

By subtracting the height sitting from the height standing a rough approximation may be made of the length of the legs; not exact, however, as we do not sit on the beginning of our legs, but on a point some two or three inches from it. Measurements taken later give more accurate results in the same direction.

Length of Trunk. (See cut No. 8.) With the subject in the position assumed for height, sitting as erect as possible, measure the distance from the seventh cervical vertebra to the box on which he sits. It is



No. 8.

sometimes difficult to find the spinous process of the seventh cervical vertebra. Direct the individual to bend his neck forward as far as possible. It will then be made more apparent than under ordinary conditions. From its prominent position it is called the vertebra prominens. The distance can be measured either with a tape or with the height measure, but should always be taken while sitting. The simpler method is with the height measure.

This measurement of length of trunk is one of the most valuable of all. By it we arrive at the only real knowledge that we have of the length of the body. It is a well-known fact that the long marches in our late war could be better endured by men with long bodies than by those with shorter bodies. The length of the trunk, in connection with the depth and width of the body, enables one to form a judgment of a man's endurance and vitality. They give the size of the vital-organ box, and tell how much room the heart, lungs and abdominal organs have for their operations. In selecting men for teams in athletic work, where vitality and endurance are essential, it is wise to bear these facts in mind. Short-bodied, long-legged men are not generally enduring.

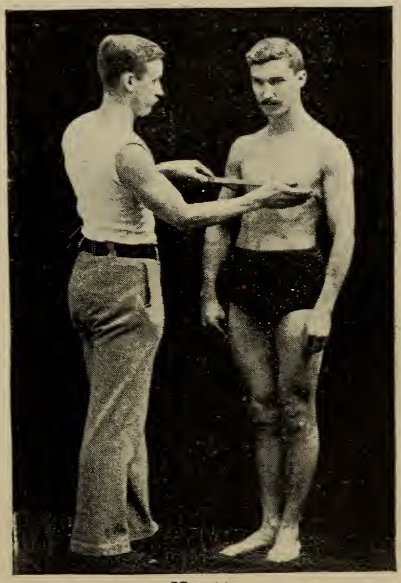
No. 9.

BREADTHS. Breadth of Neck. (See cut No. 9.) "Taken at the narrowest part, with the head of the subject erect and the muscles of the neck relaxed."

Breadth of Shoulders. (See cut No. 10.) "With the subject standing in a natural position, elbows at the sides, shoulders neither dropped forward nor braced backward, measure the broadest part two inches below the acromion processes." This measurement gives the leverage on which the arms work. It is commonly noted that men with very narrow shoulders, other things being equal, are not so strong in this part of the body as those with wide shoulders.

No. 10.

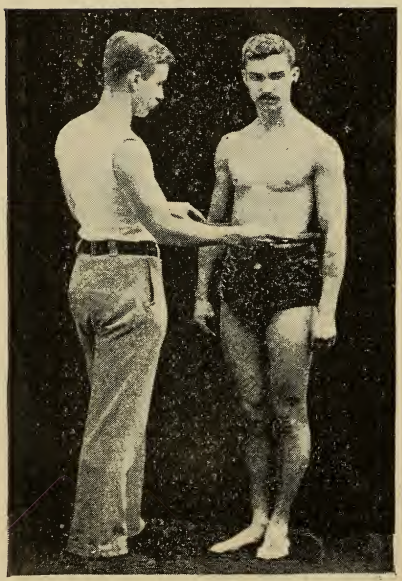
Breadth of Chest—Contracted and Expanded. (See cuts Nos. 11 and 12.) Take the first measurement after a complete expiration; and the second after a full inspiration. "Place one foot of the calipers on each side of the chest, directly across the nipples, in contact with the projecting part of the ribs."



No. 11.

No. 12.

This measurement has usually been taken with the chest at "natural," but many believe that the above method is the most satisfactory. This, with the depth of chest contracted and expanded, gives a knowledge as to whether the individual is most elastic in antero-posterior or lateral directions. We can thus give breathing exercises to bring up the deficient function.

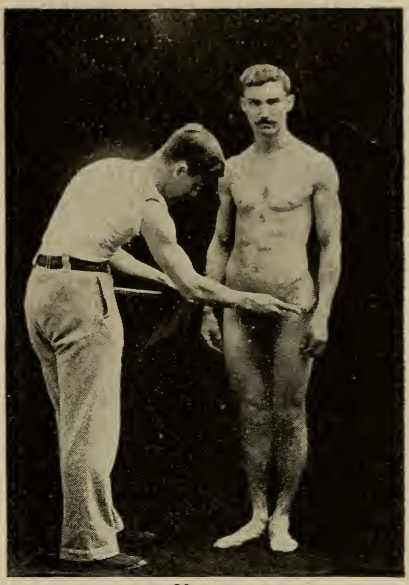


No. 13.

Breadth of Waist. (See cut No. 13.) "Taken at the narrowest part."

Breadth of Hips. (See cut No. 14.) "Measure the widest part over the trochanters, while the subject stands with feet together, and weight resting equally on both legs."

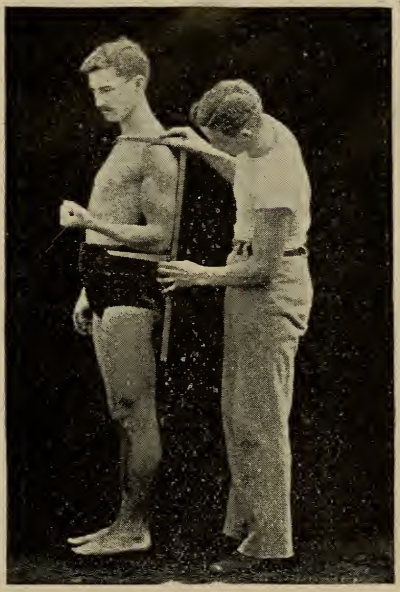
This measurement gives the leverage of the body with reference to the hips. It is rare to find a man with narrow hips and a powerful waist. All work involving twisting or bending the body from side to side demands good leverage. Wrestling will be found to demand good hips.



No. 14.

LENGTHS. Length of Shoulder to Elbow. (See cut No. 15.) "With the arm of the subject bent sharply at the elbow and held at the side, measure from the top of the acromion process to the olecranon. Care should be taken that the measuring rod is parallel with the humerus and not with the external surface of the arm."

These measurements are useful not merely in determining growth, but in ascertaining the capacity of the individual for excellence in any given sport. There seems to



No. 15.

No. 16.

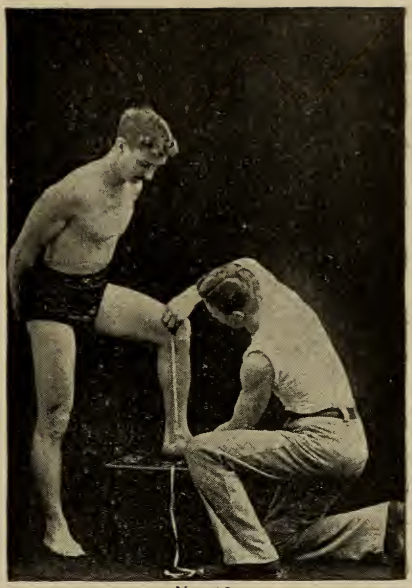
No. 17.

be a vital connection between the length of the levers of the arms and legs and the sport that the individual is best fitted to undertake.

Length from Elbow to Knuckle. (See cut No. 16.) With the forearm held at a right angle with the upper arm, measure from the tip of the olecranon to the middle knuckle of the hand. A measurement similar to this has been taken from the olecranon to the tip of the middle finger. It does not seem that this is as valuable as the measurement proposed, for the lever used is from the elbow to the hand, not from the elbow to the wrist.

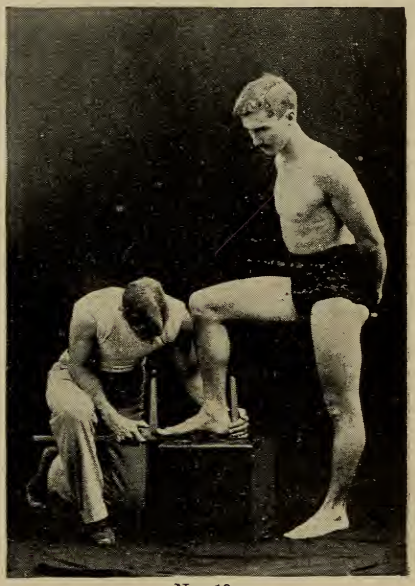
Length of Femur. (See cut No. 17.) With one foot on the thirteen inch box, measure from the great trochanter of the femur to the inferior border of the anterior surface of the patella.

LENGTH OF TIBIA. (See cut No. 18.) Measure from the prominence just to the inside of the patella caused by the anterior superior border of the articular surface of the tibia, to the centre of the internal maleoleus.



No. 18.

LENGTH OF FOOT. (See cut No. 19.) "Take the extreme length of the foot from the end of the first or second toe to the back of the heel, about one inch above the surface upon which the foot rests."



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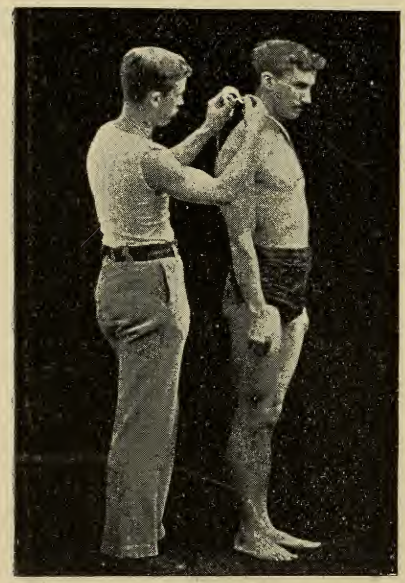


No. 20.

DEPTHS. Depth of Chest—Contracted and Expanded. (See cut No. 20.) Take the first measurement after a complete expiration, and the second after a full inspiration. "Place one foot of the calipers on the sternum midway between the nipples, and the other foot on the spine at such a point that the line of measurement is at right angles with the spinal column." (See remarks under "Breadth of Chest.")

No. 21.

Depth of Abdomen. (See cut No. 21.) "Place one end of the calipers immediately above the navel, and the other on the spine at such a point on the line of measurement that it will be at right angles with the spinal column."

It will usually be found that a person markedly deficient in depth of abdomen has not that vigorous digestive power that is essential to robust health; a fair-sized rounded abdomen is nearly always found where there is first-class digestion.

GIRTHS. GIRTH OF NECK. (See cut No. 22.) "With the head of the subject erect, pass the tape around the neck, half way between the head and body, or just below the 'Adam's Apple.'"

This measurement gives information in two directions, both of which are valuable: first, in regard to symmetry or the relative proportion of the neck to the body; second, in regard to vitality or power of resisting untoward surroundings. The connection between the size of the neck and the power of resisting is not known. It is one of the many facts that can be proved, but cannot be explained. It may be that it bears some relation to the fact that in the neck are the vital passages—the æsophagus, carotid arteries and the windpipe,—although what connection there is between the fact of these going through the neck and a man's having a large or small neck is rather difficult to imagine.

No. 22.

GIRTH OF CHEST CONTRACTED. (See cut No. 23.) With the arms of the subject held in a horizontal position while the tape is being adjusted and then allowed to hang naturally at the side, measure the girth.

Girth of chest contracted is placed before girth expanded, thus allowing the tape to be adjusted but once while this and the following measurements are being taken.

Girth of Chest Expanded. "With the arms held in the same position, pass the tape around the chest so that it shall embrace the scapulæ and cover the nipples."

In order that this measurement be taken accurately considerable care must be exercised. The tape should pass behind so as to cover the tips of the scapulæ and then be drawn around in front. The tape must not be held by the arms against the sides of the chest and then drawn backward, as this will allow a measurement several inches too large. It is a good thing to have a looking-glass placed against the wall in such a position that the examiner while standing in front of the individual can see that the tape is snug behind him. This will save much in convenience and will add materially to the accuracy of the work done.

No. 23.

The design of these two measurements is to show the mobility of the ribs and not primarily the amount of alteration that can be produced by breathing alone. *It is allowable to have the individual contract the muscles of the chest, back, and abdomen, thus throwing the contents of the abdominal cavity towards the thorax, expanding the chest wall. It is allowable in the contracted measure to raise the shoulders, thus drawing tense the pectoralis major.* If these were the only measurements of the chest this certainly would

not be fair, but the girth at the ninth rib gives us a knowledge of the amount of variation that can be produced by breathing with far greater accuracy than is possible over so much muscular tissue.

GIRTH AT NINTH RIB (CONTRACTED AND EXPANDED.) (See cut No. 24.) The first measurement is taken after a complete expiration and the second after a full inspiration, with the tape midway between the lower border of the pectoralis muscle and lowest free rib, and adjusted at right angles to the spinal column.

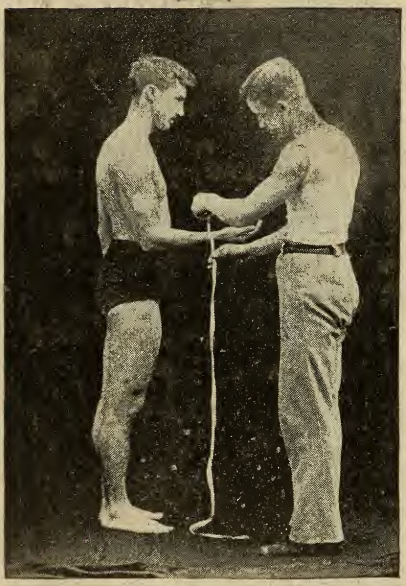
GIRTH OF WAIST. (See cut No. 25.) "The waist should be measured at the smallest part, after a natural inspiration."

This, with the depth and width of the abdomen, gives us a pretty accurate knowledge of the room that a man has for his digestive apparatus.

No. 24

No. 25

No. 26.



No. 27.

Girth of Hips. (See cut No. 26.) "The subject stands erect with feet together. Pass the tape around the hips, over the pubes, the trochanters, and the gluteal muscles."

In connection with the breadth of the hips this gives data for estimating the relative development of the gluteal muscles.

Girth of Wrist. (See cut No. 27.) "With the hands of the subject open and the muscles of the forearm relaxed, measure between the styloid process and the hand."

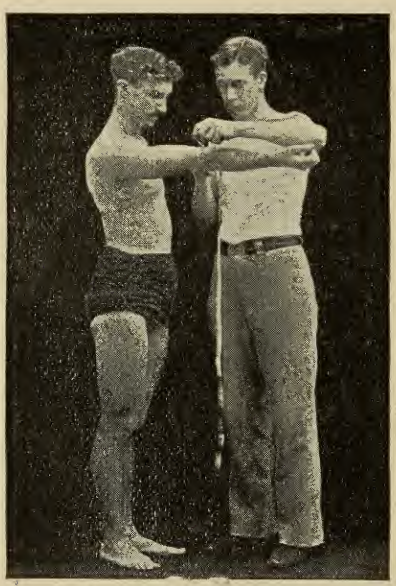
This is one of the measurements that has seemed to many almost worthless. In its relation, however, to the size of the forearm it is of considerable value, for evidently one's forearm should be in proportion to one's own wrist and not to that of some one else. Referring for a moment to a personal experience, for a long time I endeavored to increase the size of my forearm, because it was below the average. But I learned that my forearm was already symmetrical with relation to my own

wrist, which is small, and that further development would only have made it non-symmetrical.

GIRTH OF FOREARM. (See cut No. 28.) "The tape should be passed around the largest part. The fingers should be clinched and the palm of the hand be turned upward."

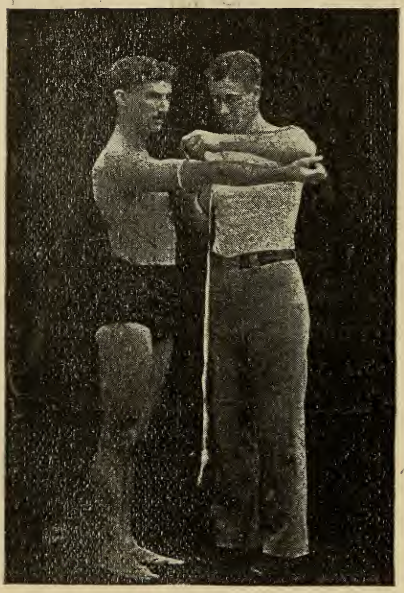
No. 28.

It will often be noticed that long continued training and a large increase in the strength of the fore-arm may not be followed by any apparent increase in the girth of these muscles themselves. This will frequently be due to the fact that the increased power here is often secured by the apparent lengthening of the bellies of the muscles. Thus, while at first the largest part of the fore-arm is near the elbow and from that point it rapidly diminishes in size towards the wrist, later on, after development, a point three and a half inches from the elbow will be as large as the former measurement, while the former measurement may not have increased at all.



No. 29.

GIRTH OF ELBOW. (See cut No. 29.) "Taken around the internal condyle of the humerus while the arm of the subject is straight, with the muscles of the forearm relaxed."



No. 30.

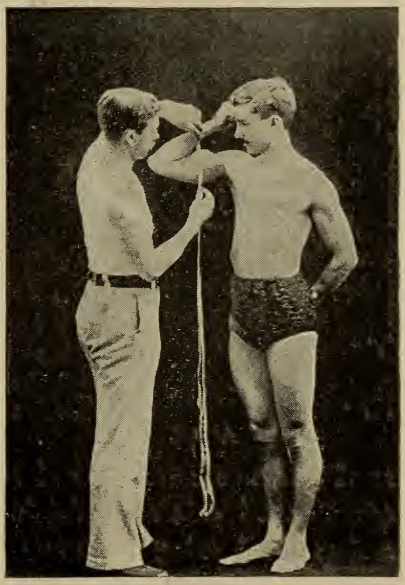
GIRTH OF UPPER ARM DOWN. (See cut No. 30.) "The arm of the subject should be held in a horizontal position, and measured around the most prominent part."

This measurement, together with the girth of the upper arm up, has often been taken with the arm by the side, when, by pressure against the side, the measurements can

be increased from half an inch to an inch. But the method suggested above gives a record as nearly as possible uniform and exact, rather than one secured by squeezing the muscle.

Another frequent mistake is to take this measurement with the muscles vigorously contracted, as is done in the case of the forearm and of the upper arm up. And there seems to be no reason for doing so in these two latter cases, except to satisfy the curiosity of the young man who is being measured..

GIRTH OF UPPER ARM UP. (See cut No. 31.) "With the arm of the subject bent hard at the elbow, contracting the biceps, and held away from the body in a horizontal position, pass the tape around the greatest prominence." Let the palm be held towards the shoulder.



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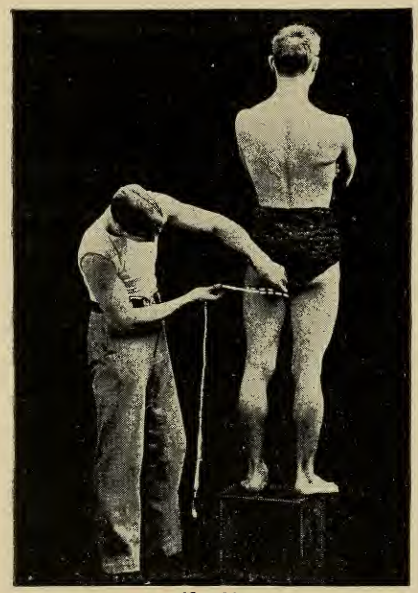

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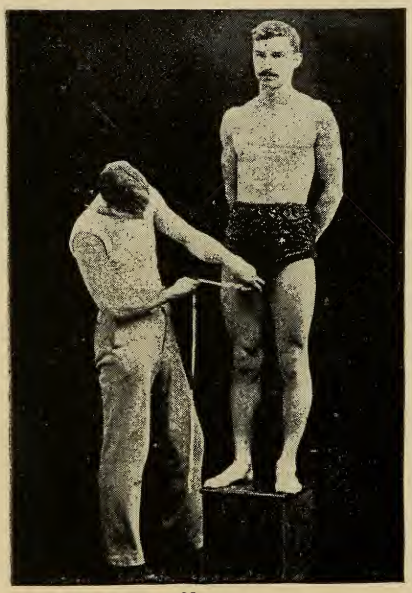


No. 33.

GIRTH OF THIGH. (See cuts Nos. 32 and 33.) "With the feet of the subject about six inches apart, the muscles set just enough to sustain the equilibrium of the body, and the weight distributed equally on each leg, measure around the thigh just below the nates."

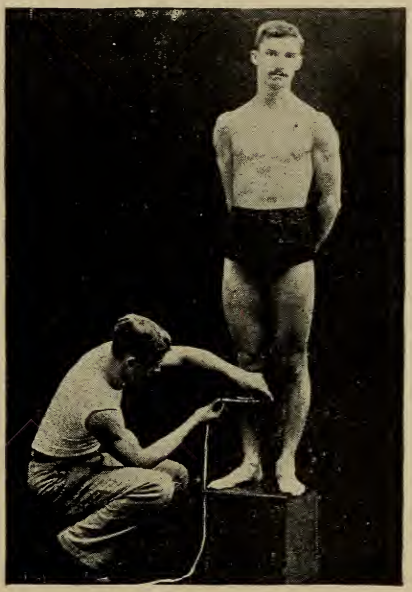
The director should take notice that the weight rests equally on both feet, as by shifting the weight from one foot to the other the measurements would be much larger than they should be. It is well at this point for the subject to take his stand on the thirteen-inch box. This makes the measurement of the thigh, knee, calf, etc., more easy than it otherwise would be.

Girth of Knee. (See cut No. 34.) With the knee of the subject straight and the weight of the body equally supported on both legs, measure from the center of the patella.

Why should joints be measured? For the sake of determining symmetry and of giving an estimate of the size of the bones. Of two legs of equal girth, the one with the smaller bone will have the more muscle. Another object of joint measurement is to give us some knowledge of the leverage afforded at that joint. The smaller the joint the poorer will be the leverage.

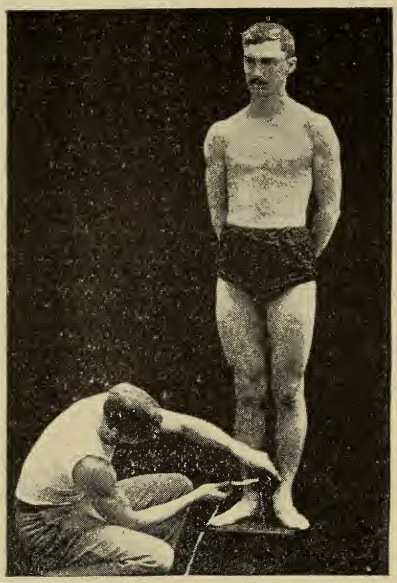
No 34.

Girth of Calf. (See cut No. 35.) "With the heels down and the weight of the body distributed equally on both feet, the tape should be passed around the largest part of the calf."



No. 35.

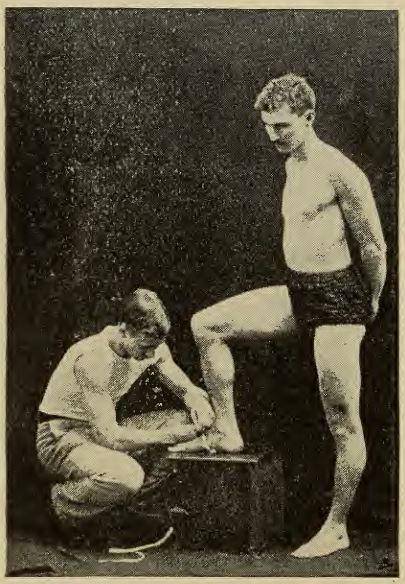
This measurement should not be taken, as many have taken it,



No. 36.

with the foot and leg to be measured placed on a chair; this alters the measurement.

Girth of Ankle. (See cut No. 36.) Should be taken at the smallest place.



No. 37.

Girth of Instep. (See cut No. 37.) "Measure around the instep at right angles with the top of the foot, passing a point at the top of the foot midway between the end of the great toe and the back of the heel." It is interesting to notice the relative proportions of this measurement in different classes of athletes.

TESTS. Heart Rate. (See cut No. 38.) The rate of the heart should be ascertained before and immediately after the strength tests; accordingly, two spaces are given it. Sometimes it will be rapid before the tests and not more so afterwards. The early rapidity in such a case would probably be due to nervousness. When the heart does not beat as rapidly after the second examination as it did after the first, an increase in the strength of the organ is indicated. A weak heart beats fast readily; a strong one does not.

No. 38.

Cardiac murmurs will sometimes be heard after the strength tests that are not heard before, particularly just below the left clavicle. This does not necessarily indicate heart disease, as these murmurs may be produced in many perfectly well-ordered hearts by vigorous muscular exercise for a few moments.

Lung Capacity. (See cut No. 39.) "After inflating the lungs to their utmost capacity, blow

No. 39.

slowly into the spirometer. Three trials may be allowed. Record the greatest one." This also is to be taken both before and after the strength tests. The nearer the individual is to perfect condition for running, rowing, etc., the nearer equal these two tests will be. A marked difference between them would indicate that the heart and lungs required further training.

Strength Tests show the apparent muscular strength of the individual. The word "apparent" is used intentionally. It is a well-known fact that two individuals of equal muscular force, as far as can be judged, will not necessarily manifest this equality in strength tests. One may be able to far surpass the other. We say of this man that he has more "nerve" or "grit" or "sand." *He tries harder* than the other, although the other man tries as hard as he can. He has the capacity for stimulating his muscles more than the other. Thus he will be able to accomplish much more in the matter of strength tests than the other individual who has equal strength of muscle. To vary the illustration, two individuals might be on record as having the same muscular strength, as indicated by these tests; while in reality one is a slight, nervous man, and the other is quite fully developed, but of a phlegmatic, quiet nature. At first sight it would seem that this factor destroyed the value of the strength tests. This, however, is not the case, for there are several things that indicate to which of these two classes the individual belongs. A glance at his measurements, his weight among others, will show at once his general construction; that is, whether slight or robust. His temperament also gives a clue, and the size of the muscles is another valuable indication. By these means one can tell approximately whether a man's strength tests are due primarily to his ability to enforce vigorous contraction from small muscles, or whether he has in reality a strong muscular system.

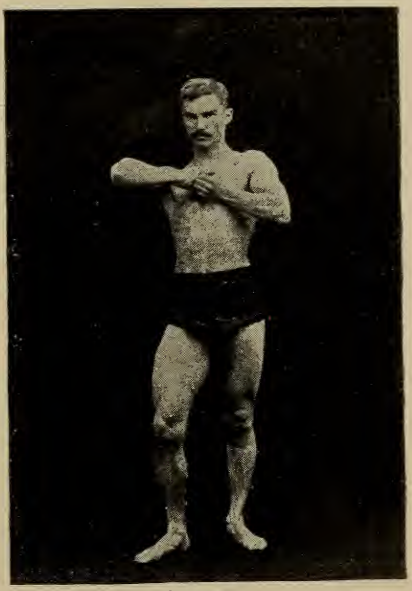
Another indication given by the strength tests is concerning the endurance of the individual, as they should be taken one following the other, giving a few seconds only after each test in which to "catch the breath," but not enough to rest in.

Strength of Forearm. (See cut No. 40.) "The subject while holding the dynamometer so that the dial turns inward, should squeeze the spring as hard as possible."

The hand holding the dynamometer should be held free from the body and not be resting upon anything during the pressure. With the dial turned toward the palm, the fingers will not interfere with the record.

No. 40.

Strength of Chest. (See cut No. 41.) Grasp the grip dynamometer with the hands, so that the palms shall be towards each other, and push them together with the greatest force possible. This test and the next may be used when the weakness of the individual does not allow the use of the dip and pull up.



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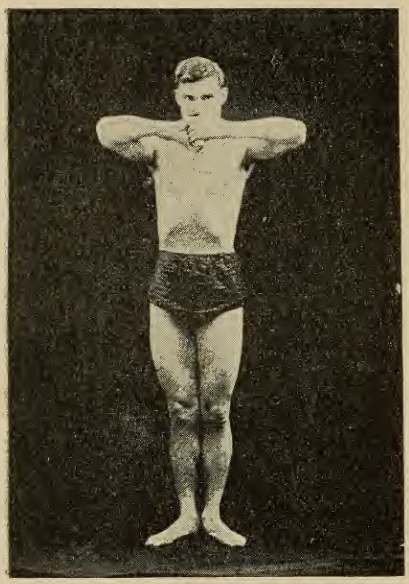


No. 42.

Strength of Upper Back. (See cut No. 42.) With the hands in a similar position and pulling in opposite directions, pull as hard as possible.

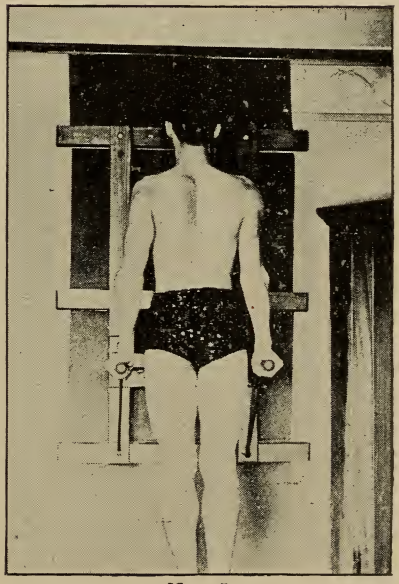
No. 43.

Strength of Back. (See cut No. 43.) "The subject standing upon the iron foot-rest, with the dynamometer so arranged that, when grasping the handles with both hands, his body will be inclined forward at an angle of sixty degrees, should take a full breath, and, without bending the knees, give one hard lift, mostly with the back."

Strength of Legs. (See cut No. 44.) "The subject while standing on the foot-rest, with the body and head erect and chest thrown forward, should sink down, by bending the knees, until the handle grasped rests against the thighs; then taking a full breath, he should lift hard, principally with the legs, using the hands to hold the handle in place."

No 44.

Dip. (See cuts Nos. 45 and 46.) "The subject while holding a position of rest upon a pair of parallel bars, supporting his weight with his arms straight, should let the body down until the chin is level with the bars, and then push it up again until the arms are firmly extended.



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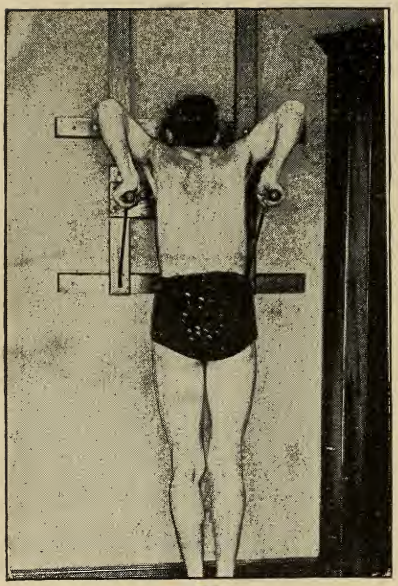
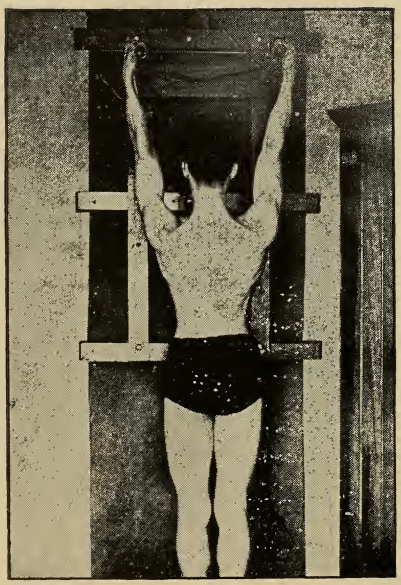


No. 46.

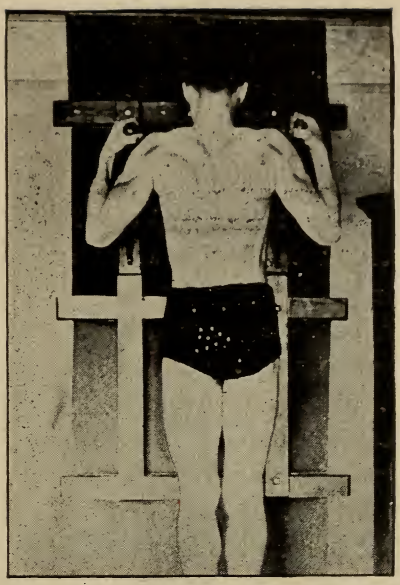
Note the number of times that he can lift himself in this manner." Some will be inclined to favor themselves in doing the dip, in not letting their bodies down, but only coming partly down and immediately pushing up again. This, of course, should not be allowed.



No. 47.

PULL UP. (See cuts Nos. 47 and 48.) "The subject should grasp a pair of parallel bars or rings, and hang with his feet clear from the floor while the arms are extended. Note the number of times that he can haul his body up until his chin touches the bar or the ring."

A tendency will be found with those that desire to make as good a record as possible on the pull up not to let themselves down fully each time. This should be guarded against.



No. 48.

MUSCLES. CONSISTENCY. The letters in the blank stand respectively for Very Hard, Hard, Medium, Soft, and Very Soft. Cross out the word which, in the examiner's mind, will best describe the individual in question. Care should be taken to form the judgment simply upon the consistency, letting alone the question of size or development.

These three things, consistency, development and size, are a sort of epitome of a man's muscular system. After six months' faithful work in the gymnasium a man may show no marked increase in any measurement, but if these three tests show, as they probably will, that he has advanced from being "Soft" to "Medium," the success of work will be indicated.

Muscles. Development. The letters here stand for Very Good, Good, Medium, Poor, and Very Poor. They should be used in the same way as just indicated. Great care should be taken to consider development irrespective of size.

This matter is of considerable importance, as it is the only thing in the measurements that gives any idea of a man's capacity for development. Thus, no matter what a man's measurements may be, if he has already come pretty near the limit of development, he need not expect to alter them materially by exercise. Another with the same muscle measurements might have a very much greater *capacity for development,* and thus would be able to show results of exercise by an increase of measurements that the first would not. This question of development has reference not at all to the size, but simply to the relation of the present size of the muscles of the individual to the size that they are capable of assuming. Thus it is a well known fact that all individuals are not capable of having the same sized muscles. We frequently see men that, in spite of careful living and a generous supply of food, sleep, and systematic exercise, are still thin and wiry ; while scores of others, without the attention to food, rest, and exercise that the first give, run up large measurements. Thus, two young men come into the gymnasium with the same measurements. One, however, has muscles that are about as well developed as they can be in that individual; while the muscles of the other are poorly developed, compared with what they could and should be. The physical director will tell the one whose muscles are undeveloped that he will be able to increase them considerably, and the other that he need not expect

to increase the size of his muscles, but that he must seek other results from exercise, such as muscular control, physical judgment, etc.

The formation of judgment regarding this matter is difficult and cannot be acquired at once. My own method is as follows: I let the man contract his deltoid vigorously by directing him to press upwards against my own hand, which is placed on his wrist. I then feel of the deltoid, and look at it to see if I can distinguish the bundles of fibres that stand out so clear and round when the muscle is well developed. I then have him contract the pectoralis major by pressing his hands together with great force in front of his body: then I direct him to extend a leg forcibly, thus examining his quadriceps extensor. I then have him rise on his toes, while I note the calf. My judgment based on these particulars I indicate on the blank. The whole matter can be done almost at a glance if one has become familiar with the signs. It will often be found that the muscles of the leg are well developed, while those of the arm are not. A place for each is left in the blank.

MUSCLES. SIZE. The letters refer to Very Large, Large, Medium, Small and Very Small. This is, of course, a summing up of the muscle measurements given before, but with the size of the bones underlying them left out.

VITAL CAPACITY. This refers to the size of the trunk, and is made up from multiplying the length of the trunk by the average between the depth of the chest and the depth of the abdomen, this again being multiplied by the average between the width of the chest and the width of the waist. This number does not represent the cubical size of the body, although it varies in a general way with it.

PENTATHLON RECORD. The Pentathlon is a test of a man's ability to run, jump, pole vault, and throw the hammer. It is scored numerically, in such a way that the record is absolute and does not depend on the relative position held in competition with others. This gives a better idea of the individual all round than anything else in this series of tests. The others refer very largely to the matter of force of the muscular system. This refers to the functions of the muscular and nervous systems, and is thus of great importance. Score cards can be obtained from the International Committee.

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